NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

UNDERGROUND OUTLET

(Feet)

Code 620

DEFINITION

A conduit installed beneath the surface of the ground to collect surface water and convey it to a suitable outlet.

PURPOSE

Dispose of excess water from terraces, diversions, subsurface drains, surface drains, trickle tubes or principal spillways from dams (outside the dam area only), or other concentrations without causing damage by erosion or flooding.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

1. Excess surface water needs to be disposed of.

2. A buried outlet is needed for Conservation Practice Standards: *Diversion (Code 362), Terrace (Code 600), Water and Sediment Control Basin (Code 638),* or similar practices.

3. An underground outlet can be installed that will safely dispose of excess water.

4. Surface outlets are impractical because of stability problems, climatic conditions, land use, or equipment traffic.

CRITERIA

Capacity. The underground outlet shall be designed, alone or in combination with other practices, with adequate capacity to ensure that the terrace, diversion, or other practices function according to the standard for the specific practice. For example, an underground outlet can be used in combination with a grassed waterway or a surface drain to carry part of the design flow. The capacity of the underground outlet for natural or constructed basins shall be adequate for the intended purpose without causing excessive damage to crops, vegetation, or improvements.

Inlet. An inlet can be a collection box, a perforated riser, or other appropriate device. Its capacity shall be adequate to provide the maximum design flow in the conduit. Flow-control devices shall be installed as necessary. Perforated risers must be of durable material, structurally sound, and resistant to damage by rodents or other animals. If burning of vegetation is likely to create a fire hazard, the inlet shall be fire resistant. Blind inlets can be used where they are effective. Collection boxes must be large enough to facilitate maintenance and cleaning operations. The inlet must have an appropriate trash guard to ensure that trash or other debris entering the inlet passes through the conduit without plugging. It must also have an animal guard to prevent the entry of rodents or other animals.

Perforated riser inlets shall have a minimum inside diameter of 5 inches. The inlet or inlet holes shall not be used to control discharge. All intake openings shall be smooth and burr free. The inlet capacity shall be equal to or greater than the design discharge rate used to compute basin storage volume. The inlet capacity shall be calculated assuming 50% of the openings on the side are plugged and the water surface is at 70% of the maximum ridge height.

Inlet caps or screens shall be removable on inlets with orifice plates. The maximum screen opening shall not exceed 1/2 the orifice diameter on inlets with orifices.

Orifice plates, when used, shall be made of metal or durable plastic, fit tight against the seat

and have a smooth edge. Use exhibit 8-5 in Chapter 8 of National Engineering Handbook , Part 650 (Engineering Field Manual), to determine the capacity of orifice plates. Appropriate equations should be used to determine the capacity of other types of devices which restrict flow. Submergence of the orifice will reduce the orifice head. Use the reduced head to determine submerged orifice capacity.

Pressure-relief wells shall be designed and installed as needed to control pressure. If junction boxes and other structures are needed, they shall be designed and installed in a manner that facilitates cleaning and other maintenance activities.

Hydraulics. Underground outlets shall be continuous conduits, tubing, or tile. Joints shall be hydraulically smooth, and the materials and methods used shall be recommended by the manufacturer. If a pressure system is used, joints shall be adequate to withstand the design pressure, including surges and vacuum. The maximum velocity must not exceed the safe velocity for the conduit materials and installation.

Lines shall be adequate to carry the design flow when the outlet and all inlets are operating at design capacity. Positive grade shall be maintained in all sections of an underground outlet. Capacity shall be based on the pipe size or on other flow control devices to prevent water from the upper inlets from discharging through the lower inlets. The minimum conduit diameter shall be 4 inches.

Conduit line capacity will be determined by using the following Manning's "n" values:

Conduit Type	Mannings "n"
Smooth Plastic	0.011
Smooth Iron and Corrugated Plastic Tubing 3" to 8" diameter	0.015
Corrugated Plastic Tubing 10" to 15 " diameter	0.017
Corrugated Metal Pipe	0.025

The hydraulic grade line (HGL) between successive inlets will approximate the difference in ground elevations at the inlets for:

- all inlets orificed
- no inlets orificed

The HGL slope must be determined if there is a mixing of inlets with and without orifice plates on a conduit line. Orifices when mixed with non-orificed inlets must be checked for submergence. Vertical drop in this section should be taken from the maximum water surface elevation at the last inlet for a non-orificed inlet and from the orifice elevation for an orificed inlet. The vertical drop shall be corrected for tailwater and for special outlet installations.

Changes in conduit diameter on pressure systems shall be made at the tee joint immediately upstream from the inlet. The tee diameter must be equal to or greater than the diameter of the conduit downstream from the inlet.

The minimum diameter of offset lines connecting inlets to conduits shall be 4 inches.

Materials. Materials shall meet or exceed the design requirements against leakage and shall withstand internal pressure or vacuum and external loading. Plastic, concrete, aluminum, and steel shall meet the requirements specified in the applicable ASTM standard. All materials specified for Conservation Practice Standard *Subsurface Drain (Code 606)* can be used for underground outlets. Conduits, however, can be perforated or non-perforated, depending on the design requirements. A filter fabric wrap (sock) or equivalent shall be used if migration of soil particles around conduit is anticipated. All exposed plastic materials shall be protected from degradation due to exposure to sunlight.

Outlet. The outlet shall be sufficiently stable for all anticipated flow conditions. It shall be designed for the maximum anticipated water surface at design flow. A continuous section of rigid conduit having a minimum length of 10 feet or a headwall shall be used at the outlet. If a closed conduit is used, it shall be durable and strong enough to withstand all anticipated loads, including those caused by ice. Outlets shall not be placed in areas of active erosion. If fire is a hazard, the outlet shall be fire resistant. All outlets must have animal guards to prevent the entry of rodents or other animals. Animal guards must be hinged to allow passage of debris.

When discharging an underground outlet into a pond or lake, the minimum elevation of the pipe

invert shall be at the normal level of pond or lake. When the outlet is located near an area of sediment deposition along the shoreline, the minimum elevation of the outlet pipe invert shall be at least 1.0 foot above the normal water elevation.

The outlet pipe and its installation will conform to the following requirements:

1. If burning vegetation on the outlet ditch bank is likely to create a fire hazard, the material from which the outlet pipe is fabricated must be fire resistant. If the probability is great, the outlet pipe must be fireproof.

2. If plastic pipe is used, it shall meet one of the following:

- Polyvinyl chloride (PVC) with SDR equal to 35 or less or schedule 40 or greater.

- High-density polyethylene (HDPE) ASTM-D3350 flexural modulus cell class 4 or greater, conforming to ASTM F-714 for smooth wall HDPE or ASHTO M-250 or M-294 for double wall HDPE pipe. The materials will typically have a standard dimension ratio value of 32.5 or less or pipe stiffness value of 34 psi or greater, respectively.

3. If corrugated metal pipe is used, it shall meet one of the following:

- Corrugated steel pipe will have a minimum thickness of 0.064 inches, conforming to ASTM A-760, A762 and A-885.

- Corrugated aluminum pipe will be riveted or helical fabrication with a minimum thickness of 0.069 inches, conforming to ASTM B-745 and B-790.

4. Two-thirds of the pipe shall be buried in the ditch bank and the cantilever section must extend to the toe of the ditch side slope or the side slope must be protected from erosion. The minimum length of the pipe will normally be 8 feet. For conduits 10 inches in diameter or greater, longer outlet sections shall be considered, such as:

- 10 inches and 12 inches in diameter, use 12 feet.

- 15 inches and 18 inches in diameter, use 16 feet.

- Use 20 feet outlet pipe for all diameters larger than 18 inches.

5. If ice or floating debris may damage the outlet pipe, the outlet shall be recessed to the extent that the cantilevered part of the pipe will be protected from the current in the outlet channel.

Protection. All disturbed areas shall be reshaped and regraded so that they blend with the surrounding land features and conditions. Visual resources must be given the same consideration as other design features. Areas that are not to be farmed or covered by structural works shall be established to vegetation or otherwise protected from erosion as soon as practicable after construction.

Seedbed preparation, seeding, fertilizing, and mulching shall be appropriate for the site-specific conditions. Refer to Conservation Practice Standard *Critical Area Planting (Code 342) f*or allowable species, seeding mixtures, and recommended seeding dates. The vegetation shall be maintained and trees and shrubs controlled by hand, machine, or chemicals as necessary.

CONSIDERATIONS

Installation of this practice should be in consideration of natural resource assessments that may be applicable, such as cultural resources, NEPA, wetland conservation provisions, existing wildlife habitat, and others.

Consider effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

Consider effects on the volume of downstream flow that might cause undesirable environmental, social, or economic effects.

Evaluate potential use for water management.

Consider effects on erosion and the movement of sediment, pathogens, and soluble and sediment-attached substances that would be carried by runoff.

Consider effects on the visual quality of downstream water resources.

Consider the construction-related effects on the quality of downstream watercourses.

Consider effects on wetlands or water-related wildlife habitats.

Evaluate potential impact on water quality due to agri-chemicals in outflow.

Consider depth of underground outlet in regard to tillage equipment depth and maintenance, if applicable.

PLANS AND SPECIFICATIONS

Plans and specifications for installing underground outlets shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose.

Inspection of Materials. Materials for underground outlets shall be inspected for workmanship, physical imperfections, nominal diameter, markings and thickness before installation. All material shall meet applicable specifications and requirements.

Placement. Conduits shall be laid to line and grade shown on the plans. Bedding and blinding shall be according to the recommendations of the manufacturer, and as shown on the plans. Earth backfill material shall be placed in the trench in a manner that will not displace the conduit. Where the conduit is to pass under structures (terrace ridges, diversion ridges, etc.) the backfill material is to be compacted in 6 inch lifts to the density of the original material before excavation. All trenches excavated for underground outlets shall be completely backfilled in such a manner that the field is left reasonably level and suitable for cultivation over the installed conduit.

Protection. Markers, visible from farm equipment, should be placed at all inlets and appurtenant structures to protect them from damage by farming operations.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be established to maintain the inlets, conduits, and outlets installed as part of the underground outlet practice. Maintenance needs are to be discussed with the landowner or operator who is responsible for maintaining the practices installed under this standard.

Underground outlets shall be maintained by:

- Keeping inlets, trash guards, and collection boxes and structures clean and free of materials that can reduce the flow
- Repairing leaks and broken or crushed lines to insure proper functioning of the conduit
- Checking outlet conduit and animal guards to ensure proper functioning of the conduit
- Keeping adequate backfill over the conduit
- Repairing any eroded areas at the pipe outlet

REFERENCES

1. NRCS, National Engineering Handbook, Part 650, Engineering Field Handbook Chapters 8 and 14.
2. NRCS, Conservation Practice Standards: Critical Area Planting (Code 342) Subsurface Drain (Code 606)
3. General Manual, 190, Part 410, Compliance with NEPA.